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CONCENTRATION IN PIG-IRON AND COAL PRODUCTION.

BY E. W. PARKER.

A few weeks since, in response to a request of a correspondent, I compiled a statement showing to what an extent the manufacture of pig-iron is following the tendency of many other industrial enterprises,— that is, concentration in the hands of comparatively few large concerns, and thus resulting in the freezing out or absorption of the individual producers and smaller corporations. The results of my investigations show some very interesting facts. My information was gathered from the files of the *American Manufacturer* at Pittsburg, in which city I happened to be at the time. The *American Manufacturer* publishes once a month a statement of the condition of the blast furnaces in the United States during the preceding month, the statements being compiled from direct returns of the producers. These show the number of furnaces in blast — charcoal, anthracite and bituminous, and coke — with the total weekly capacity of each. My investigations extended back only as far as 1890, and the results are shown in the accompanying tables. In January, 1890, the total number of furnaces in blast was 345, with a total weekly capacity of 175,002 tons of pig-iron, or an average weekly capacity per furnace of 507 tons. In January, 1898, the total number of furnaces in blast was 190, with a total weekly capacity of 227,979 tons of pig-iron, an average weekly capacity per furnace of 1252.5 tons. Observe that the number of furnaces in blast has decreased from 345 to 190, a difference of 155, the number of furnaces in blast in January, 1898, being only 55 per cent of the number in blast in January, 1890. The total weekly capacity, however, has increased from 175,000 tons to 228,000 tons, a gain of 30 per cent, while the average individual capacity increasing from 507 tons to 1252.5 tons shows that the average output per furnace in January, 1898, was two and one-half times what it was in 1890. The development of these conditions since 1890 has been remarkably regular and persistent. In January, 1890, the average capacity per furnace was, as stated, 507 tons. In the opening months of the succeeding years it was as follows: 1891, 537 tons; 1892, 618 tons; 1893, 703 tons; 1894, 780 tons; 1895, 933 tons; 1896, 981 tons; 1897, 1022 tons. In July, 1897, it was 1165 tons; in November, 1897, 1187 tons, and reaches its highest figure in January, 1898, with 1252.5 tons. The decrease in the number of furnaces in blast has not been so regular, but at no time since 1890 has the number been so large as it was in that year. In January, 1894, the number of furnaces in blast was only 132, while in July of the same year the number had fallen to 111, the average capacity per furnace being 780 tons at both periods. This was a year of great depression in the iron industry, following the panic of 1893, and the production of pig-iron amounted to only 6,657,388 tons, the smallest output in the period under review, being but little more than two-thirds of the production in either 1890 or 1897. In January, 1896, the number of furnaces in blast was 240, the capacity being 981 tons per furnace. The first half of this year (1896) was one of great activity, the production in the first six months being larger than in any other similar period with the exception of the latter halves of 1895 and 1897. In July of 1896 the number of furnaces in blast had decreased to 191, again to 160 in January, 1897, to 143 in July, increasing with the industrial revival of the latter part of 1897 to 185 in November, and 190 in January, 1898.

Considering the same proposition according to the kinds of fuels used, we find that the number of charcoal furnaces has decreased from 66 in January, 1890, to 15 in January, 1898, less than one-fourth. (In December, 1897, there were 21 charcoal furnaces in blast.) The total weekly capacity has declined from 12,693 tons in 1890 to 4725, showing the production of charcoal iron in January, 1898, to be little more than one-third of what it was in 1890; but when we consider the average capacity per furnace we find the same rule obtains as for the total. In January, 1890, the average capacity per furnace was 192 tons per week, while in January, 1898, it was 315 tons, an increase in individual capacity of 64 per cent. Among the anthracite furnaces there has also been a decrease in production, the total capacity in January, 1890, being 41,954 tons, while last January it was 20,669 tons, less than one-half. The number of furnaces in blast has decreased from 111 in January, 1890, to 29 in 1898, a difference of 82, or 74 per cent. But here again in spite of these decreases we find a large increase in the average capacity per furnace. In 1890 the average weekly capacity per furnace was 378; in 1898 it is 713, an increase of 88 per cent.

The proportion of decrease in the number of furnaces using bituminous coal and coke has been less than in the others. Against 168 furnaces in blast in January, 1890, we have 146 in blast in January, 1898. But in this line we see no decrease in the total weekly capacity. On the other hand, the total weekly capacity has increased from 120,345 tons to 202,585 tons, a gain of about 66⅔ per cent, while the average capacity per furnace has increased from 716 tons to 1388, nearly double.

It is interesting to note in connection with this that there are only two important iron-producing districts in which there has been an increase in the number of furnaces in blast in the eight years under review. In the Illinois, Missouri, and Wisconsin district there were 16 furnaces in blast in 1890, and 19 in 1898, a gain of three. There have been as many as 21 in January, 1896, while in January, 1894, there was but one. In the Pittsburg or Allegheny county (Penn.) district, the most important one in the country, there was a gain of eight, from 21 in 1890 to 29 in 1898. In December, 1897, there were 30 furnaces in blast. The lowest number was 16 in July, 1894. In the Shenango Valley, Pa., there were 16 in 1890, and 11 in 1898, a loss of 5. In the —

	1890.	1898.	Loss.
Juniata and Conemaugh Valleys, Pa.	13	7	6
Virginia and Maryland	12	10	2
Mahoning Valley, Ohio	13	10	3
Eastern, Central, and Northern Ohio	14	14	0
Tennessee and Kentucky	13	10	3
Georgia and Alabama	23	18	5

In regard to the average weekly capacity of the furnaces in these districts we find that there have been the following changes: —

	1890.	1898.	Per cent of Increase.
Allegheny County	1,130	1,982	75
Shenango Valley	701	1,522	117
Juniata and Conemaugh Valleys	466	1,325	184
Virginia and Maryland	609	824	35
Mahoning Valley	841	1,515	80
Eastern, Central, and Northern Ohio	803	1,391	73
Tennessee and Kentucky	423	663	57
Georgia and Alabama	600	1,112	85
Illinois, Wisconsin, and Missouri	991	1,691	71

In not one of the districts does the total productive capacity show a decrease. In the Allegheny county district the total capacity increased from 23,731 tons to 57,461; Shenango Valley from 11,223 to 16,738 tons; Juniata and Conemaugh Valleys from 6055 to 7949; Virginia and Maryland from 7309 to 8242; Mahoning Valley from 10,938 to 15,150; Eastern, Central, and Northern Ohio from 11,250 to 22,250; Tennessee and Kentucky from 5497 to 6634; Georgia and Alabama from 13,814 to 20,009; Illinois, Wisconsin, and Missouri from 15,854 to 32,134.

As to whether this increased productive capacity has been the result of or the cause of the lower prices of iron and steel, and the manufactures thereof, I shall not attempt to say. That they have attended each other is true. In 1890 the average price of No. 1X foundry pig-iron in Philadelphia was $18.40 per ton. Ten years before it was $28.50. In 1870 it was not far from $50. (In 1872 it was $48.88.) In February, 1898, the price of this grade of pig-iron in Philadelphia is quoted at $12 to $12.25.

According to Mr. James Gayley of the Carnegie Steel Co. this increased individual furnace capacity has been the result of several causes. First may be mentioned an increased diameter of hearth ; second, a greater depth of hearth, so that more carbon could be burned below the tuyeres ; third, improved blowing machinery and an increased number of tuyeres, all of which may be summed up as providing means for a more rapid combustion of the carbon in the hearth of the furnace, as on this depends the product of the furnace.

Mr. John Fulton, of Johnstown, adds a fourth cause — an increase in the heat of the blast. Mr. Gayley states that there have been some changes made in the hot-blast stoves, but he is not convinced in his own mind that the changes are improvements. These improvements of hearth, blast, and tuyeres have done more than increase the capacity of the furnace. A no inconsiderable item in the economies resulting from improved furnace practise is the reduction in the amount of fuel consumed. In 1890 one ton of pig-iron with 2000 pounds of coke (equivalent to one and one-half tons of coal) was considered good work. A good furnace today will use only 1800 pounds of coke, per ton of pig, showing that a saving of 10 per cent has been effected in the fuel.

There are two other factors which have had an important bearing on the increased capacity of the blast furnaces and the lowering of the cost of production ; one is the protecting of the bosh walls of the furnace with bronze bosh cooling plates, thus protecting the walls at this point, resulting in prolonging the youth of the furnace, and maintaining the output far beyond a period when formerly furnaces were blown out for repairs. Mr. Gayley claims that the use of these bosh plates reduces the fuel consumption. Finally, we must take into consideration the improved mechanical appliances for handling the furnace charge. These have been made necessary by the larger capacity and output, and have followed the other changes.

Having this history of the iron industry before me, I have compiled from the records of the Geological Survey a statement in regard to the production of coal. My object was to see how far, if at all, coal mining had shown a similar tendency. My investigation covered the six years from 1891 to 1896, inclusive. I took for consideration the output of bituminous coal mines, producing (1) less than 10,000 tons per annum, (2) from 10,000 to 50,000 tons, and (3) over 50,000 tons. The figures show that the proportion produced by the smaller mines remained practically constant at 4 per cent of the total, the middle class varied from 16 to 21 per cent, being 17 per cent in 1891 and 16 per cent in 1896, while the larger class varied from 74 to 80 per cent, being 79 per cent in 1891 and 80 per cent in 1896.

If the coal mining interests have not as yet shown the same degree of consolidation, indications unmistakably point to this result. The prices of both anthracite and bituminous coals have been showing a declining tendency for several years. In 1887 the general average price of bituminous coal was $1.12 per ton of 2000 pounds. In 1888 and 1889 it was $1.00. During the next three years it was 99 cents, falling to 96 cents in 1893, to 91 cents in 1894, to 86 cents in 1895, and reaching the lowest notch, 83 cents in 1896. This is a decline of 27 per cent in 9 years. The statistics for 1897 are not sufficiently advanced to be able to state what the average price was for the year. It is possible that the two months' strike may have resulted in an advance in value for the time that will show an improvement in the price, but this should not be taken as an indication of better conditons. Since 1887 and to the close of 1896 there was not a single reaction against the declining tendency in the bituminous coal trade. Anthracite prices declined from $2.01 per short ton in 1887 to $1.43 in 1890. Restricted production in the anthracite region in 1892 and 1893 brought the prices up to $1.57 and $1.59, respectively, while an output in excess of demand in 1985 reduced the price to $1.41 per short ton, this figure being obtained by dividing the total value by the total product including colliery consumption. Anthracite is, however, always sold at the mines by the long ton of 2240 pounds. Excluding the item of colliery consumption, the average price for all coal marketed in 1895 was $1.72 per long ton. This figure represented a net loss of 8.1 cents on every ton of coal mined by the Philadelphia & Reading Coal & Iron Co., approximately $1,000,000, while the Lehigh Valley Coal Co. lost 13.48 cents on every ton of coal mined and purchased. The anthracite operators got together in 1896, restricted production and put the price up to $1.85 per long ton at the mines. The shipments from the anthracite region in 1896 amounted to 43,177,485 long tons. The estimated domestic consumption was 42,344,222 tons, the exports, 1,350,000 tons, making a total of about 43,695,000 tons, the deficiency being made up by stocks carried forward from 1895. The estimate made by the Anthracite Coal Operators Association, of domestic consumption in 1897, puts the figures at 38,159,000, — the exports approximately were 1,300,000 tons, making a total, say, of 39,460,000 tons. The shipments from the region during the year were about 41,200,000 tons, making a surplus of production over consumption and exports of over 1,700,000 tons*. It is the surplus that demoralizes prices, and we shall doubtless see, when the returns for 1897 are all in, that lower prices for coal, causing in turn a reduction of wages among the miners, were responsible for the deplorable affair at Hazelton last summer. Bituminous coal operators are between two fires,—a strong mine workers' union on the one hand, demanding and receiving higher remuneration, and surplus production and falling prices on the other. In the light of present knowledge it is hard to see how any relief is to be obtained unless advantage is taken of the economies in operation, which can only be effected by increased production at larger plants and the closing down of smaller mines.

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* Since the above was written the returns to the Geological Survey show that the shipments of anthracite coal in 1897 amounted to a little over 41,600,000, so that the surplus would be 2,100,000 tons. There was not, however, any decline in the selling price of anthracite as compared with 1896. The price per long ton, considering all marketable sizes, was $1.85 in both years.

INCREASING BLAST FURNACE CAPACITY.

Total Number of Charcoal, Anthracite, and Coke Furnaces in Blast in the United States, and Their Total and Average Weekly Capacity on the Dates Named. (Tons, 2240 Pounds.)

Date.	Charcoal.			Anthracite and Coke.			Bituminous and Coke.			Total.		
	No. Furnaces in Blast.	Total Weekly Capacity.	Average Weekly Capacity.	No. Furnaces in Blast.	Total Weekly Capacity.	Average Weekly Capacity.	No. Furnaces in Blast.	Total Weekly Capacity.	Average Weekly Capacity.	No. Furnaces in Blast.	Total Weekly Capacity.	Average Weekly Capacity.
Jan. 1, 1898..	15	4,725	315	29	20,669	713	146	202,585	1,388	190	227,479	1,252
July 1, 1897..	15	3,282	219	26	18,913	727	102	144,363	1,415	143	166,558	1,165
Jan. 1, 1897..	21	6,356	302	32	19,525	610	107	137,695	1,287	160	163,576	1,022
July 1, 1896..	26	7,686	295	39	25,812	662	126	165,437	1,313	191	198,935	1,046
Jan. 1, 1896..	21	5,379	256	59	39,714	673	160	190,287	1,189	240	235,380	981
July 1, 1895..	16	3,584	224	38	20,847	549	133	140,448	1,056	187	164,879	882
Jan. 1, 1895..	24	5,395	225	37	21,182	572	127	148,800	1,172	188	175,377	933
July 1, 1894..	24	4,016	167	30	12,972	432	57	69,541	1,220	111	86,529	780
Jan. 1, 1894..	19	3,759	198	30	15,303	510	83	83,937	1,011	132	102,999	780
July 1, 1893..	37	8,268	223	65	28,463	438	128	124,221	970	230	160,952	700
Jan. 1, 1893..	40	9,045	226	70	31,167	445	140	135,489	968	250	175,701	703
July 1, 1892..	43	10,358	241	74	32,075	433	140	127,417	910	257	169,850	661
Jan. 1, 1892..	56	12,448	222	93	39,631	426	161	139,363	866	310	191,442	618
July 1, 1891..	51	10,589	208	92	35,977	391	154	120,858	785	297	167,424	564
Jan. 1, 1891..	61	12,459	204	102	41,952	411	143	109,870	768	306	164,281	537
July 1, 1890..	62	13,234	213	114	45,038	395	164	120,423	734	340	178,695	526
Jan. 1, 1890..	66	12,693	192	111	41,954	378	168	120,345	716	345	175,002	507

Number of Furnaces in Blast and their Total and Average Weekly Capacity in the Following Districts on the Dates Named.

Date.	Allegheny County, Pa.			Shenango Valley, Pa.			Juniata and Conemaugh Valleys, Pa.			Virginia and Maryland.			Mahoning Valley, Ohio.			Eastern, Central, and Northern Ohio.			Tennessee and Kentucky.			Georgia and Alabama.			Illinois, Missouri, and Wisconsin.		
	Number of Furnaces in Blast.	Total Weekly Capacity.	Average Weekly Capacity Per Furnace.	Number of Furnaces in Blast.	Total Weekly Capacity.	Average Weekly Capacity Per Furnace.	Number of Furnaces in Blast.	Total Weekly Capacity.	Average Weekly Capacity Per Furnace.	Number of Furnaces in Blast.	Total Weekly Capacity.	Average Weekly Capacity Per Furnace.	Number of Furnaces in Blast.	Total Weekly Capacity.	Weekly Capacity Per Furnace.	Number of Furnaces in Blast.	Total Weekly Capacity.	Weekly Capacity Per Furnace.	Number of Furnaces in Blast.	Total Weekly Capacity.	Weekly Capacity Per Furnace.	Number of Furnaces in Blast.	Total Weekly Capacity.	Weekly Capacity Per Furnace.	Number of Furnaces in Blast.	Total Weekly Capacity.	Weekly Capacity Per Furnace.
Jan. 1, 1898..	29	57,461	1,982	11	16,738	1,522	6	7,949	1,325	10	8,242	824	10	15,150	1,515	16	22,250	1,391	10	6,634	663	18	20,009	1,112	19	32,234	1,697
July 1, 1897..	25	50,992	2,039	4	5,944	1,486	6	7,011	1,168	11	10,151	923	4	5,873	1,468	9	12,026	1,336	7	5,593	799	15	16,837	1,122	11	20,255	1,841
Jan. 1, 1897..	23	47,118	2,048	5	7,459	1,492	6	6,018	1,003	11	9,255	841	8	11,861	1,483	8	9,730	1,216	8	5,356	669	15	17,471	1,165	8	11,825	1,478
July 1, 1896..	21	41,460	1,974	9	13,201	1,467	10	11,189	1,119	11	9,768	888	6	8,382	1,397	12	15,499	1,292	9	7,397	822	17	18,936	1,114	15	26,681	1,779
Jan. 1, 1896..	23	43,592	1,895	11	12,210	1,110	11	11,637	1,058	18	13,011	723	11	14,276	1,298	15	20,113	1,341	12	9,003	750	20	19,625	981	21	32,960	1,570
July 1, 1895..	24	39,026	1,626	14	15,823	1,130	7	7,104	1,015	10	5,416	542	9	10,068	1,119	12	11,756	980	8	5,166	646	18	17,667	982	14	18,347	1,311
Jan. 1, 1895..	24	41,815	1,742	15	17,108	1,141	8	9,444	1,180	9	5,803	645	8	9,636	1,204	13	14,919	1,148	7	4,977	711	15	14,911	994	12	20,018	1,668
July 1, 1894..	16	28,525	1,783	0	0	0	1	250	250	8	4,869	609	0	0	0	4	6,387	1,597	5	3,641	728	9	8,282	920	7	12,986	1,855
Jan. 1, 1894..	18	29,997	1,667	9	9,250	1,028	6	5,025	838	11	7,633	694	4	4,544	1,136	7	6,746	964	7	3,156	451	12	11,534	961	1	619	619
July 1, 1893..	23	36,342	1,580	11	10,959	996	10	8,156	816	12	9,577	798	8	9,122	1,140	12	10,785	899	8	4,313	539	18	13,385	744	8	12,223	1,528
Jan. 1, 1893..	23	36,278	1,577	8	8,692	1,087	10	7,794	779	15	10,100	673	10	10,482	1,048	12	11,574	965	9	5,285	587	21	15,794	752	13	17,430	1,341
July 1, 1892..	23	34,389	1,495	6	5,780	964	9	6,059	673	14	8,597	614	9	8,607	956	13	11,453	881	9	5,409	601	24	15,927	664	14	21,442	1,538
Jan. 1, 1892..	21	31,597	1,505	14	12,840	917	13	7,881	606	15	9,489	633	10	9,908	991	13	11,594	892	12	5,572	464	26	17,987	692	17	21,391	1,250
July 1, 1891..	24	31,753	1,323	15	12,384	826	11	5,665	515	13	8,316	640	11	9,227	839	11	9,146	831	11	5,254	477	23	15,214	661	13	14,404	1,108
Jan. 1, 1891..	22	29,141	1,325	11	7,791	708	12	6,248	521	13	7,804	600	8	6,786	849	15	12,866	858	12	5,627	469	14	9,309	665	14	15,367	1,098
July 1, 1890..	20	25,064	1,253	17	12,770	751	12	6,004	500	13	8,188	630	12	9,943	829	13	10,028	771	10	4,182	418	28	16,711	597	17	17,062	1,004
Jan. 1, 1890..	21	23,731	1,130	16	11,223	701	13	6,055	466	12	7,309	609	13	10,938	841	14	11,250	803	13	5,497	423	23	13,814	600	16	15,854	991